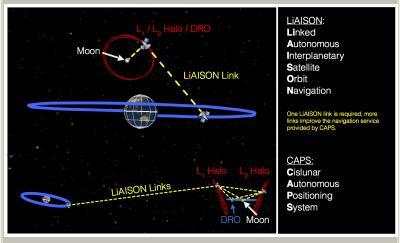
Small Business Innovation Research/Small Business Tech Transfer

Cislunar Autonomous Positioning System (CAPS), Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

Recent efforts led by the PI of this proposal have studied the benefits of a satellite navigation technique known as Linked Autonomous Interplanetary Satellite Orbit Navigation (LiAISON). LiAISON makes it possible to achieve absolute, inertial navigation of two or more satellites using only relative satellite-to-satellite tracking data. LiAISON removes the need for ground tracking and permits a constellation to achieve autonomy with on-board navigation software. A good example of LiAISON involves one satellite traversing a libration orbit about the Earth-Moon L2 point (perhaps providing communication services to the lunar far-side) and another satellite traversing a low lunar orbit. The time-series of range data between the two satellites is unique in that it cannot be reproduced by any other two orbits. The uniqueness of these two orbits based on their relative position and/or velocity permits the estimation of the absolute positions of both spacecraft. Another example configuration places one satellite in a distant retrograde orbit about the Moon (a desirable orbit for many mission concepts including Orion, the Asteroid Redirect Mission (ARM), and various Mars sample return concepts) and a second satellite anywhere else in cislunar space. Numerous recent academic studies have shown that processing satellite-to-satellite tracking data for these vehicles yields absolute navigation states for both vehicles. Extensive academic studies have demonstrated the feasibility of this algorithm over the past 10 years. Advanced Space proposes to develop this innovative technology into a robust, expandable in-space navigation system, simulated through a representative real-time environment, positioning it for infusion into spaceflight missions. The resulting system lays the foundation for the proposed Cislunar Autonomous Positioning System (CAPS), which infuses the strength of LiAISON into an operational network.



Cislunar Autonomous Positioning System (CAPS), Phase I Briefing Chart Image

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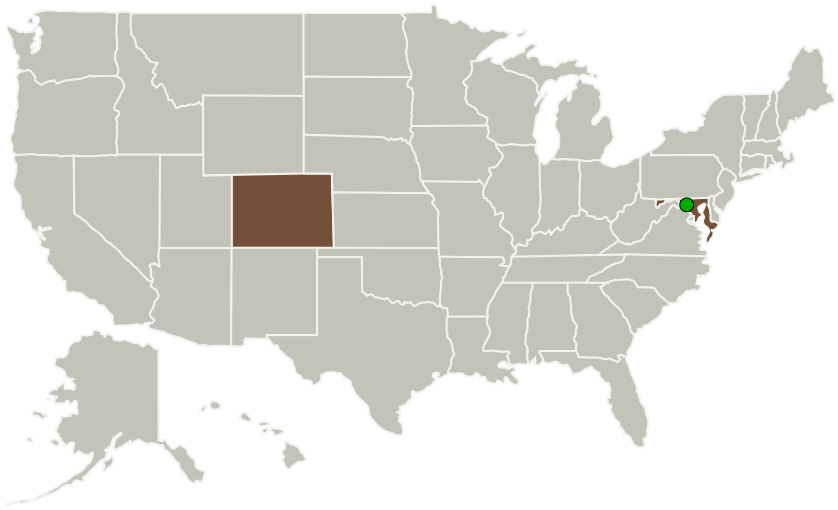
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Advanced Space, LLC	Lead Organization	Industry	Boulder, Colorado
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Colorado	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Space, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

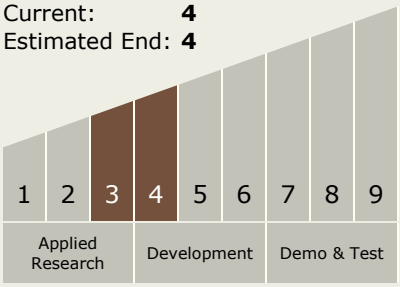
Carlos Torrez

Principal Investigator:

Jeffrey E Parker

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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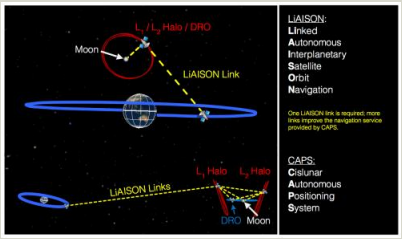
Images



Briefing Chart Image
Cislunar Autonomous Positioning System (CAPS), Phase I Briefing Chart Image
(https://techport.nasa.gov/image/134914)

Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.2 Navigation Technologies
    - TX17.2.3 Navigation Sensors